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Using the Moon to facilitate exploration of Near Earth Objects

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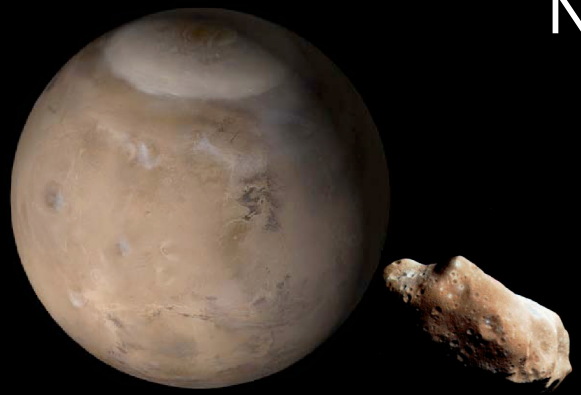
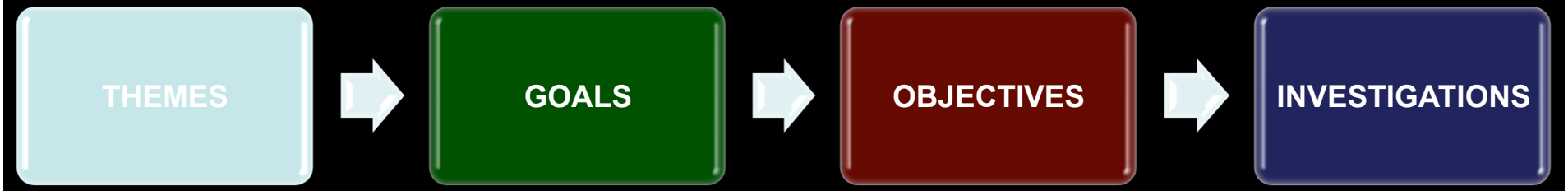


The Lunar Exploration Roadmap

http://www.lpi.usra.edu/leag/ler_draft.shtml



Three Themes:

- Science (Sci)
- Feed Forward (FF)
- Sustainability (Sust)

Sustainability is the key:

- Transition strategy outlined;
- Commercial “on ramps” are defined;
- International cooperation is critical.

The Lunar Exploration Roadmap

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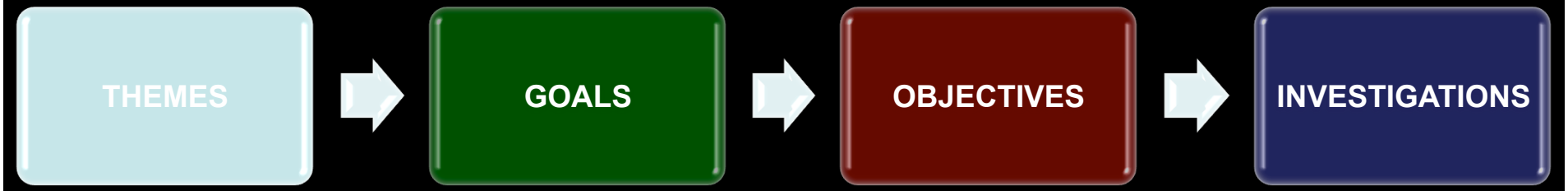

Feed Forward Theme: Initial version Mars-centric;

Mars Risk Reduction Value:

How well do the candidates address the key risk reduction areas identified through NASA's robotic and human Mars mission planning studies.

Lunar Platform Value:

Do candidates leverage the unique attributes of a lunar program to achieve success – or – would other platforms be more effective from a technical/cost perspective.

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Feed Forward Theme Expanded in 2010:

- Goal FF-A: Identify and test technologies on the Moon to enable robotic and human solar system science and exploration;
- Goal FF-B: Use the Moon as a test-bed for missions operations and exploration techniques to reduce the risks and increase the productivity of future missions to Mars and beyond;
- **Goal FF-C: Use the Moon to prepare for future missions to Small Bodies.**

Lunar Exploration to Enable NEO Exploration

Pros:

- Harsh space environment;
- Proximity;
- International cooperation is critical;
- Dust/regolith issues;
- ISRU;
- Similarity in (some) Technological Developments.

Con:

- Gravity.

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Lunar Exploration Roadmap

Goal FF-C: Use the Moon to prepare for future missions to Small Bodies.

Evaluation Criteria:

Small Body Mission Risk Reduction Value: How well do the candidates address the key risk reduction areas identified through NASA's Small Body robotic and human mission planning studies.

Lunar Platform Value: Do candidates leverage the unique attributes of a lunar program to achieve success – or – would other platforms be more effective from a technical/cost perspective.

Overarching objectives for Goal FF-C:

- Ability to operate on a Geologic Surface.
- Operations on Airless bodies.
- Operating in an extreme Radiation environment.
- Long duration mission activities.

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Using the Moon to prepare for future missions to Small Bodies

Technology Developments

- Sampling & Preservation Technologies – volatiles, ices, regolith;
- Robotic Sample Return/Curation Technologies;
- Radiation protection technologies.

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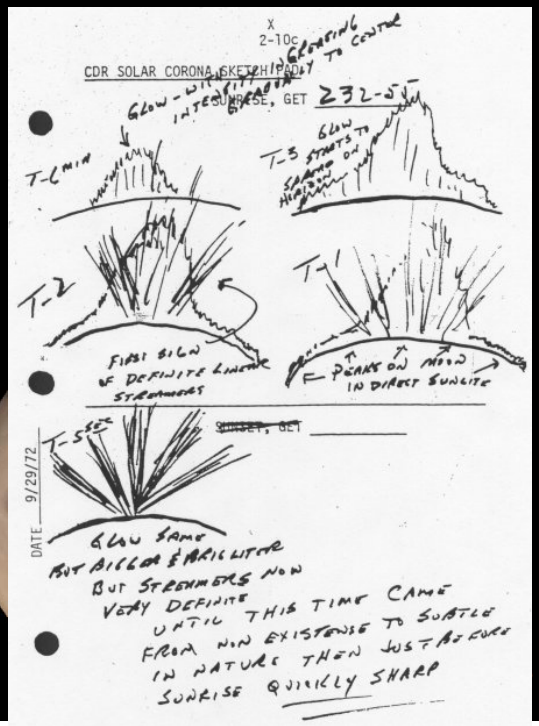
Using the Moon to prepare for future missions to Small Bodies

Different lighting conditions – EVA light to dark transitions (perception under different shadow/lighting regimes).



Plasma-dust environment = Electrostatic issues.

Apollo 17 Dust Sketch

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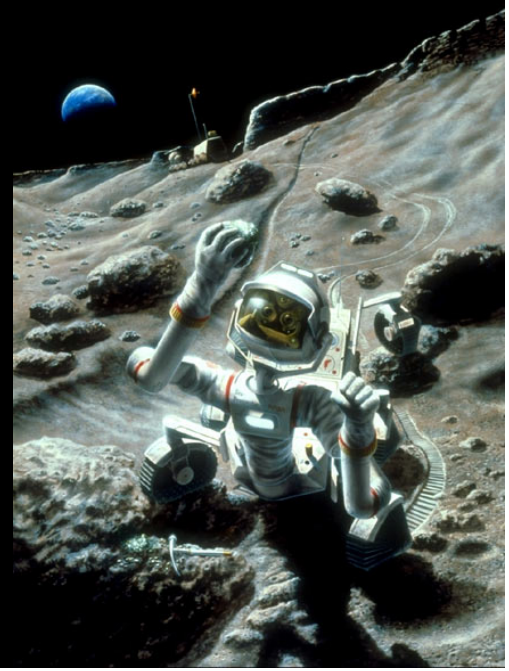
Using the Moon to prepare for future missions to Small Bodies

- Thermal regimes for equipment doing EVA. More constant on the Moon, but could test equipment on the Moon for NEO exploration.
- Robotic-human interactions (teleops, efficiency plans, etc.).
- Mitigation of suit/tool failures and wear-and-tear due to dust interaction. Airlock ports.



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Using the Moon to prepare for future missions to Small Bodies

- **Radiation Environment**: tissue equivalent dosimeters exposed for long periods, so applicable to any deep space mission. Testing on radiation shielding strategies and technologies.
- **ISRU** – initial emphasis on prospecting. Both volatiles and metals. Some business cases have been outlined, which need to be explored in detail.

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Using the Moon to prepare for future missions to Small Bodies

The Moon is an Exploration Asset:

- Technology Development (robotic & human science and exploration);
- Protection technologies for human missions;
- Systems Integration for human missions.